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Adolescent Loneliness during the COVID-19 Pandemic: The Role of Pre-Pandemic Risk Factors

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Abstract

The COVID-19 pandemic is a global mental health crisis that disproportionately impacts adolescents. Loneliness is a particularly salient pandemic psychosocial outcome to understand; however, research to date on this outcome is sparse and largely cross-sectional. In response, we examined pre-pandemic risk factors for pandemic loneliness. Further, we examined how risk may differ based on key demographics, and whether mediation or moderation models best explained potential disparities in experiencing loneliness. Self-reported, pre-pandemic mental health, trauma exposure, and family conflict survey data were collected at Wave 1 in a diverse sample of 369 adolescents (54.5% female, 45.5% male; 30.1% White; 30.9% Black; 18.4% Hispanic; $M_{age} = 15.04$; $SD_{age} = 1.10$). Subsequently, self-reported experiences of loneliness during the pandemic were collected 6 months (April-June 2020) and 12 months (October-December 2020) later. Using a regression-based framework (i.e., PROCESS), we tested (a) which pre-pandemic risks uniquely predicted prospective loneliness and (b) whether loneliness risk was elevated for certain identities (i.e., mediation models) or whether certain identities were more sensitive to specific risks (i.e., moderation models). Overall, pre-pandemic depressive and aggression symptoms predicted early pandemic loneliness (6-month follow-up), whereas anxiety symptoms specifically predicted mid-pandemic loneliness (12-month follow-up). Environmental stressors were moderated by gender, such that females with pre-pandemic trauma exposure were more likely to report pandemic loneliness. Further, pre-pandemic internalizing distress for girls and externalizing symptoms for boys, reflected gender-specific pathways for loneliness. Implications for mental health prevention in the wake of national disasters are discussed.

Keywords COVID-19 · Loneliness · Longitudinal · Developmental psychopathology

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1 Introduction

In March 2020, the World Health Organization (World Health Organization, 2020) deemed COVID-19 a worldwide pandemic. Subsequently, necessary societal restrictions were installed to contain transmission within the United States (Ren, 2020). These restrictions disrupted daily activities and introduced new stressors within families (e.g., Adalja et al., 2020; Guessoum et al., 2020). These stressors have contributed to rising mental health concerns, in particular, adolescent psychological distress (e.g., Leeb et al., 2020; Patrick et al., 2020). In fact, the Surgeon General recently issued a warning for a youth mental health crisis in response to the COVID-19 pandemic (Richtel, 2021). Despite these developments, studies examining psychological sequelae among youth is lacking, with investigators (e.g., Racine et al., 2020) and organizations (e.g., United Nations, 2020) emphasizing the need to fill this gap. In response, the current study examined pre-pandemic predictors of loneliness, a critical and transdiagnostic mental health concern (Loades et al., 2020), during the pandemic in a diverse adolescent sample.

1.1 Loneliness during the COVID-19 Pandemic

Loneliness is defined as the discrepancy between adolescents' actual and desired amount of social interaction (i.e., Perlman & Peplau, 1981), or the situation in which social needs are unfulfilled (Weiss, 1973). Loneliness is a normative state encompassing cognitive and affective components (deJong-Gierveld, 1987), with rates of loneliness demonstrating increasing trends worldwide (Twenge et al., 2021). However, when experienced for a long duration, loneliness is associated with a number of poor psychological adjustment outcomes among youth, including disruptions in sleep (Harris et al., 2013) and a higher frequency of suicide attempts (Schinka et al., 2013). Despite these findings, it is important to note that recent empirical literature has called for greater clarity in identifying risk mechanisms that lead to, and ameliorate, loneliness (Osborn et al., 2021). In response, investigators conceptualize loneliness as both an outcome, as well as a risk pathway for various forms of distress and impairment.

With regard to the COVID-19 pandemic**,** stay at home orders and social distancing have been hypothesized to contribute toward elevated levels of loneliness (Loades et al., 2020). It is estimated that adolescents may be uniquely vulnerable to experience loneliness during this pandemic (Beam & Kim, 2020; Groarke et al., 2020). During the early stages of the pandemic, opportunities to interact with family members were affiliated with lower levels of loneliness (Ellis et al., 2020). Others built upon these findings by demonstrating that emotional difficulties (i.e., internalizing distress) and conduct problems/hyperactivity-inattention (i.e., externalizing distress), were positively related to loneliness, while better familial relationships were inversely associated with levels of loneliness (Cooper et al., 2021). Although these studies provide some insight into this increasingly important outcome during the ongoing public health crisis, the scope of these findings are limited to concurrent

associations. Prior investigations examining the psychological impact of public health crises have emphasized the significance of pre-crisis risk factors on mental health sequelae (e.g., Cohen et al., 2016), suggesting that the current lack of empirical work on longitudinal relations may render an incomplete picture of who is most vulnerable to pandemic-related loneliness.

1.2 Risk Mechanisms for Pandemic-Related Loneliness

A review of the theoretical literature (e.g., Vanhalst et al., 2014) highlights a number of intrapersonal and environmental processes contributing to experiences of loneliness in adolescence. At the individual level, psychological distress, including externalizing and internalizing symptoms are associated with relational tendencies that may disrupt the formation of healthy relationships (e.g., poor emotional regulation leading to hostility; Muris et al., 2003). Links between loneliness and depression appear particularly robust across adolescent identities, with depressive symptoms prospectively associated with higher levels of loneliness across community and at-risk youth samples (Lalayants & Prince, 2015; Schinka et al., 2013). Meanwhile, complementary research suggests anxiety and externalizing symptoms may lead to experiences of loneliness in adolescence via pathways unique from depression (e.g., London et al., 2007). During the COVID-19 pandemic, loneliness was uniquely associated with concurrent internalizing and externalizing symptoms (Cooper et al., 2021), suggesting unique relations between mental health subtypes and perceived isolation during the pandemic. The present study sought to build off these findings by examining the prospective relations between mental health and pandemic loneliness, and identifying if specific symptom subtypes lead to loneliness.

With regard to environment, trauma history and family relationships serve as salient predictors of loneliness. For instance, Matthews et al. (2022) found that potentially traumatic events (i.e., bullying) experienced throughout childhood predicted loneliness during adolescence. As for family contexts, previous investigators have demonstrated that perceived negative interactions with caregivers predict behaviors (e.g., withdrawal; Adams & Laursen, 2007) that may engender loneliness. While these findings explicate the relation between either trauma history or family environments for loneliness, they leave unanswered questions about incremental validity. Specifically, whether trauma history *and* family environments, along with psychological distress, confer incremental insight into adolescent loneliness. In addition, given the paucity of research examining the impacts of these contexts on COVID-19 pandemic adjustment outcomes (e.g., Harriger et al., 2021; Liu et al., 2021), further empirical evidence is needed to determine the validity of these relations as they exist within the current crisis.

1.3 Demographic Considerations

Historically, disasters exacerbate mental health disparities among racial and ethnic minority youth (e.g., La Greca et al., 1998; Lonigan et al., 1991), and COVID-19 may not be an exception (Condon et al., 2020). Most research concerning racial/

ethnic mental health disparities posits a mediation model (e.g., Birkett et al., 2014; Reisner et al., 2015), in which exposure to elevated stressors explains increased mental health risk. For example, given longstanding patterns of racial/ethnic income inequality in the United States (Manduca, 2018), Black or Hispanic adolescents may be disproportionately exposed to potentially traumatic events. Consistent with the "double jeopardy" hypothesis (Widom et al., 2013), these experiences may leave youth less-equipped to regulate emotional responses to the pandemic. As for gender, epidemiological studies have consistently delineated higher rates of internalizing symptoms among adolescent girls compared to adolescent boys (e.g., Anderson & Mayes, 2010; Merikangas et al., 2010; Ramos et al., 2003). Within the context of the present study, this may suggest that females are more at-risk for loneliness during COVID-19 due to heightened pre-existing levels of emotional distress (i.e., support for a mediation model).

An alternative risk model for explaining potential mental health disparities is via moderation, such that greater sensitivity to particular stressors may render some individuals susceptible to higher levels of distress. The moderating effect of race/ethnicity on disaster-related stressors for adolescent mental health symptoms is inconclusive, possibly due to sample size issues (e.g., Rubens et al., 2018). In contrast, due to a myriad of biological, developmental, and social reasons, adolescent girls tend to demonstrate more sensitivity to certain types of stressors, such as parent–child conflict (Weymouth et al., 2016) compared to adolescent boys (Rudolph, 2002). This disparity in sensitivity may provide a useful explanation for the higher burden of post-disaster sequelae among adolescent girls (Cheng et al., 2018). Given the different translational implications conferred by a mediation or moderation model (Cole & Turner, 1993), clarifying the role of racial/ethnic and gender disparities in symptom manifestation may inform efforts to reduce the psychological consequences of COVID-19 and future crises.

1.4 The Present Study and Hypotheses

The overarching aim of the present study is to examine pre-pandemic risk factors for loneliness in a racially/ethnically diverse adolescent sample. Based on prior research, we expected pre-pandemic trauma exposure (Hyland et al., 2019), mental health (e.g., Cooper et al., 2021) and familial conflict (e.g., Pan et al., 2021) to uniquely forecast loneliness. Recent research suggests qualitatively different responses to early pandemic and mid-pandemic contexts (e.g., Ravens-Sieberer et al., 2021), suggesting potentially different mechanisms underlying adjustment during different phases of the pandemic. Further, identifying pre-pandemic risks that predict loneliness above and beyond initial psychological responses may be particularly important for promoting long-term well-being in vulnerable youth. Thus, risk factors were examined to assess risk for both early and mid-pandemic loneliness. Finally, to address potential health disparities, we examined how risk factors varied across identities. Specifically, we tested whether loneliness risk was elevated for certain identities (i.e., mediation models) or whether certain demographic characteristics were more sensitive to our pre-selected risk factors (i.e., moderation models).

Based on extant literature (e.g., López et al., 2017; Manduca, 2018; Rudolph & Hammen, 1999), we hypothesized female adolescents would demonstrate heightened pre-pandemic internalizing symptoms (support for a mediation model) and greater sensitivity to family conflict (support for a moderation model), while adolescents who identified as non-White would report greater pre-pandemic adversity, and thus, be more at risk for loneliness via a mediation model. These hypotheses are illustrated in Fig. 1 for clarity.

1.5 Materials and methods

1.5.1 Participants

Participants for the current study were recruited as part of an ongoing longitudinal study examining pathways to distress and resilience across different forms of trauma exposure within adolescence. The baseline visit of the study occurred prior to the COVID-19 lockdown procedures. Given the widespread effect of the pandemic, the investigators introduced questions assessing responses (e.g., loneliness) to the potentially traumatic experience of the public health crisis. Adolescents who participated in the second wave of data collection during the pandemic (March-August 2020) were included in this study. Of 584 adolescents at baseline, those completing

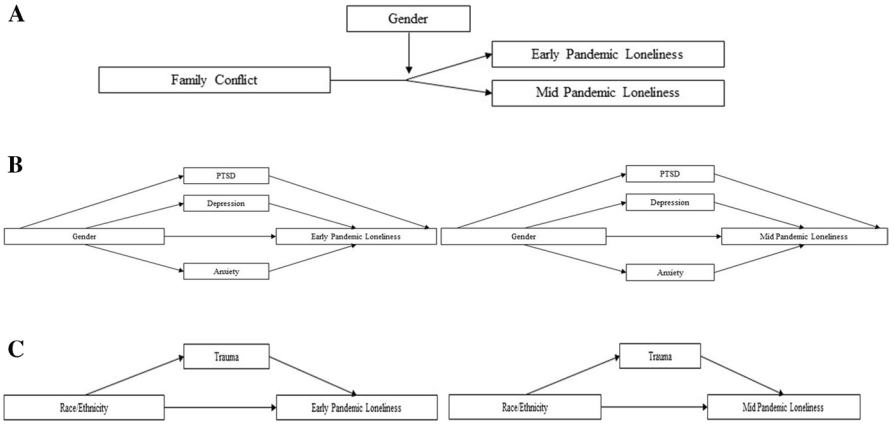


Fig. 1 **A** Visual depiction of hypothesis for the relation between family conflict and loneliness being stronger for females. **B** Visual depiction of hypothesis for the mediating role of pre-pandemic internalizing symptoms for loneliness among females. **C** Visual depiction of hypothesis for the mediating role of pre-pandemic trauma exposure for loneliness among non-White adolescents. *Note*: Gender = Female = 0, Male = 1; Loneliness = Three items adapted from the Roberts Version of the UCLA Loneliness Scale including the prompt "Since learning about the Corona Virus, have you felt the following" (Roberts et al., 1993); Family conflict = Negative interactions factor of the Network of Relationships Inventory: Behavioral Systems Version – Short Form (NRI: BSV-SF; Furman & Buhrmester, 2009). PTSD = Post traumatic stress subscale of the Trauma Symptom Checklist for Children (TSCC; Briere, 1996); Depression = Depression subscale of the TSCC (Briere, 1996); Anxiety = Anxiety subscale of the TSCC (Briere, 1996); Trauma = Adverse Childhood Experiences questionnaire (ACEs; Finkelhor et al., 2013); Race/Ethnicity = Self-reported race/ethnicity

the second survey before the pandemic ($N = 58$) and those with missing data for the second wave ($N = 157$) were excluded. To examine potential biases in our subsample, we created two groups, one group signifying those who were not included in the study ($N = 215$) and the other group capturing those who were included in the study ($N = 369$). We then conducted independent sample t-tests to compare the mean levels of baseline measures across these two groups. Surprisingly, participants in the present study demonstrated significantly higher means for PSTD ($t(208, 359) = -2.59$, $p < 0.01$), anxiety ($t(208, 360) = -2.92$, $p < 0.01$) and depressive symptoms ($t(208, 359) = -2.59$, $p < 0.01$) compared to those who did not complete the Wave 2 COVID-19 measures. Therefore, if anything, hypotheses were tested within a sample at higher vulnerability for emotional distress. Meanwhile, non-significant differences emerged for aggression, trauma exposure, family conflict, and age. Chi-square tests found significant differences between the two groups regarding gender, $\chi 2(215,369) = 12.13$, $p < 0.05$, with a higher percentage of female identifying individuals included in the study (54.5% vs 45.5%) compared to those who did not complete Wave 2 COVID-19 measures. Meanwhile, chi-square tests across race/ethnicity found no significant differences between the two groups, $\chi 2(215,369) = 1.05$, $p = 0.79$.

Participants were recruited from three schools in a large, urban setting in southeast Texas ($N = 342$), as well as juvenile justice system (JJS)-involved youth in a small Midwestern city ($N = 27$). Analyses revealed that the JJS-involved sample was younger ($M_{\text{Age}} = 13.56$, $SD = 1.31$) than the school sample ($M_{\text{Age}} = 15.16$, $SD = 1.00$), $t(27,341) = 7.85$, $p < 0.001$. In addition, the two samples differed significantly in race/ethnicity, χ^2 (3, $N = 369$) $= 10.03$, $p = 0.02$, such that more participants in the JJS-involved sample identified as White (51.9%) compared to the school sample (28.4%), while more participants in the school sample identified as Hispanic (19.9%) compared to the JJS-involved sample (0%). No significant differences were found for gender, $p = 0.85$. The two samples were equivalent across all other study variables, $ps > 0.05$, with the exception of baseline family conflict, with the JJS-involved sample reporting greater levels, $t(367) = 6.09$, $p < 0.001$. Given the relative similarity between the two samples, and the small size of the JJS-involved sample, they were combined to increase the overall power of our analyses. The final sample consisted of 369 youths between the ages of 12 and 18 ($M_{age} = 15.04$; $SD_{age} = 1.10$). The sample was demographically diverse, with regard to gender (54.5% female, 45.5% male) and race/ethnicity (e.g., 30.1% White; 30.9% Black; 18.4% Hispanic; 20.6% Other).

1.5.2 Procedure

All study procedures for the current study were approved by the Institutional Review Board at the first author's home institution. For the school sample, students were introduced to the study during class by research personnel. If interested, students brought home a description of the study along with a parental consent form. For the JJS-involved sample, a member of the study team reached out to adolescents who were either referred by a case manager at a juvenile diversion program, or recruited from a community-event that the diversion program attended. Across both sites, once child assent and parental consent were obtained, adolescents completed

a 45-min survey on demographic characteristics, life events, and mental health for the baseline assessment. These adolescents were then contacted 6 months and 1 year later for Wave 2 and Wave 3, respectively. The baseline visits of this study occurred from October through December 2019, Wave 2 from April through June 2020, and Wave 3 from October through December 2020. Baseline assessments were completed both with paper and pencil measures as well as online using tablets, while all Wave 2 and Wave 3 assessments were completed online via a Qualtrics survey. Adolescents provided a self-generated code to prevent linking their data to their identity, allowing adolescents to more comfortably answer questions concerning potentially traumatic events and risky behavior (Yurek et al., 2008). Adolescents were compensated with a $20 (USD) gift card to a nationwide retailer (e.g., Amazon) upon completion of each Wave, as well as an additional $15 (USD) if they completed all three waves. Pre-pandemic risk factors were derived from the baseline assessment, while early- and mid-pandemic loneliness data were derived from Wave 2 and Wave 3, respectively.

1.5.3 Measures

Loneliness Adolescents' early- and mid-pandemic loneliness was assessed using a three-item measure adapted from the Roberts Version of the UCLA Loneliness Scale (Roberts et al., 1993), developed specifically for the brief measurement of loneliness within adolescents. Participants were asked to indicate on a scale of 1 (*rarely*) to 3 (*often*) how much, since learning about the Corona Virus, they felt they "lack friends," are "left out," and are "lonely." In the present study, Cronbach's alpha for the loneliness scale was 0.78 (Wave 2) and 0.82 (Wave 3), suggesting good internal consistency.

Pre-existing Mental Health 34 items from the Trauma Symptom Checklist for Children (TSCC; Briere, 1996) were used to assess for pre-pandemic levels of psychological distress, consisting of the post-traumatic stress (PTSD; 10 items), depression (8 items), anxiety (7 items), and anger/aggression (9 items) subscales. Adolescents were asked to indicate the frequency of symptoms during the past 6 months, rating responses on a scale of 0 (*never*) to 3 (*almost all of the time*). Example items included, "Having bad dreams or nightmares (PTSD)," "Feeling afraid something bad might happen (anxiety)," "Feeling lonely (depression)," and "Arguing too much (anger/aggression)." Past research has established the TSCC to be a reliable and valid measure among adolescents (Sadowski & Friedrich, 2000). In the present study, Cronbach's alphas were 0.90 (PTSD), 0.86 (depression), 0.86 (anxiety), and 0.88 (aggression), suggesting good to excellent internal consistency across all four subscales.

Prior Trauma Exposure Pre-pandemic trauma exposure was assessed using an adapted 10-item Adverse Childhood Experiences questionnaire (ACES; Finkelhor et al., 2013). Adolescents were asked to answer either *yes* or *no* to questions including, "Did you often or very often feel lonely, rejected or that nobody liked you?" and

"Did a household member go to prison?". The ACES is widely used to assess for negative early life experiences, and has been found to be associated with a variety of detrimental health and social consequences in adolescents (Balistreri & Alvira-Hammond, 2016). In the current study, the ACES had a Cronbach's alpha of 0.95, suggesting excellent internal consistency.

Family Conflict Pre-pandemic family conflict was assessed through the negative interactions factor of the Network of Relationships Inventory: Behavioral Systems Version – Short Form (NRI: BSV-SF; Furman & Buhrmester, 2009). After identifying a primary caregiver, adolescents were asked six questions regarding the frequency of negative interactions with their primary caregiver, including "How much do you and this person get upset or mad at each other?" on a scale of 1 (*little or none*) to 3 (*very much*). Cronbach alpha was 0.98, reflecting excellent internal consistency.

1.5.4 Data Analytic Approach

Descriptive statistics were computed and a missing data analysis was conducted prior to testing study aims. All hypotheses were tested within a multiple regression framework with separate models for early pandemic (Wave 2) and mid-pandemic loneliness (Wave 3). Pre-pandemic risks were entered into an initial simultaneous model. As emotional distress tends to vary by age and gender (Hankin & Cohen, 2020), these characteristics were entered as covariates in all analytic models. Given the high rates of comorbidity between symptom subtypes, we utilized standardized residuals, resulting from the regression of each pre-existing mental health subscale on the remaining pre-existing mental health entities, as independent variables within analytic models. For instance, anxiety symptoms were captured via a standardized residual that reflected the unique variance of anxiety symptoms once partialing out shared variance with depression, PTSD, and aggression. To help control for false positives in the wake of partitioning (see Lynam et al., 2006), subsequent analyses tested whether the residuals, as well as the raw mental health symptom subscale scores, were identified as significant within independent regression models. Raw scores were used to index pre-pandemic environmental stressors (i.e., family conflict, ACEs). For models that used mid-pandemic loneliness as the criterion, early pandemic loneliness was entered as a covariate. Indices that were significant across simultaneous and individual models were considered predictive of our outcomes.

To test our profiles of risk within the context of race/ethnicity and gender, multiple regression models using the PROCESS framework were conducted (Hayes, 2017). Mediation models tested whether heightened levels of a given risk index explained the relation between a demographic profile and loneliness. Subsequently, moderation analyses were conducted to examine whether either gender or race/ethnicity interacted with a risk index to predict loneliness. If any risk index demonstrated both mediation and moderation (e.g., family conflict mediates the relation between gender and loneliness and gender moderates the relation between family conflict and loneliness), we tested mediation and moderation simultaneously via an exposure-mediation model (Valeri & VanderWeele, 2013). This provides a more robust test of disentangling whether a third

variable mediates or moderates a given relation (Valeri & VanderWeele, 2013). Analyses were conducted using SPSS v25.0.

Interpretation of mediation and moderation models followed extant recommendations (Hayes & Preacher, 2014; Hayes & Rockwood, 2017). For mediation models, indirect effects were calculated via the product approach. Bias-corrected bootstrap interval estimates of the product between *a* and *b* divided by the standard deviation of the outcome was used as our effect size. This effect size provides a more reliable and robust estimate of the true indirect effect compared to alternative strategies (e.g., ratio effect sizes) and can provide an effect size across a greater range of mediation contexts (e.g., inconsistent mediation; Miočević et al., 2018). Meanwhile, predicted values from significant moderators based on demographic characteristics and high (1 standard deviation above the mean) and low (1 standard deviation below the mean) levels of risk were depicted visually to illustrate profiles of risk and resilience.

2 Results

2.1 Preliminary Analysis

Table 1 provides means for all study variables. Of note, adolescents in our sample reported a marginal increase in loneliness from the beginning of the pandemic until the middle of the pandemic ($t(368) = -1.93$, $p = 0.05$). Examination of mean differences in loneliness across demographics suggested higher levels of loneliness among females compared to males, both with regard to early, $t(367) = 4.98$, $p < 0.001$ and mid $t(367) = 6.82$, $p < 0.001$ pandemic measures, while no differences were found across race/ethnicity, $ps > 0.10$. Across most variables there was minimal missing data, with the exception of mid-pandemic loneliness in which 17.1% of the data was missing (the variable with the next most missing data was family conflict: 3.3%). To examine whether the pattern of missing data was systematic, we conducted the Little's Missing Completely at Random (MCAR) statistic, in which the null hypothesis is that the data is MCAR. Results suggested the data was MCAR, $\chi^2(392) = 432.79$, $p = 0.08$, and data was subsequently imputed using the expectation maximization algorithm (Schafer & Graham, 2002). The imputed dataset was used for all subsequent analyses to reduce biases related to listwise deletion. The interrelatedness of our predictors was assessed via the Variance Inflation Factor (VIF), with values greater than 10 adversely affecting parameter estimation (Belsley, 1991). Results from a VIF analysis on our imputed dataset suggested minimal threat to interpretation (Supplemental Tables S1-S2). In Table 2, bivariate correlations are reported between all continuous variables. All variables demonstrated multiple positive correlations.

2.2 Multiple Regression Models

For our simultaneous model, all symptom indices were significant and neither ACEs nor family conflict were significant. Within our independent residualized and raw symptom analyses, only aggression and depression remained significant

Table 1 Means and standard deviations for all measures

Measures	Mean	SD	Number of Items
Gender	0.46 (0.46)	0.50 (0.50)	1
Age	4.05 (4.05)	1.11 (1.11)	1
Loneliness_W2	5.28 (5.29)	1.96 (1.97)	3
Loneliness_W3	5.46 (5.53)	1.89 (2.01)	3
PTSD	18.65 (18.70)	6.79 (6.85)	10
Depression	14.45 (14.49)	5.03 (5.07)	8
Anxiety	13.14 (13.15)	4.54 (4.57)	7
Aggression	15.49 (15.52)	5.46 (5.50)	9
Trauma	2.31 (2.32)	2.55 (2.58)	10
Family conflict	1.62 (1.61)	0.74 (0.74)	6

Gender = Female = 0, Male = 1; Age = 1 = 12, 2 = 13, 3 = 14, 4 = 15, 5 = 16, 6 = 17, 7 = 18; Loneliness = Three items adapted from the Roberts Version of the UCLA Loneliness Scale including the prompt "Since learning about the Corona Virus, have you felt the following" (Roberts et al., 1993); PTSD = Post traumatic stress subscale of the Trauma Symptom Checklist for Children (TSCC; Briere, 1996); Depression = Depression subscale of the TSCC (Briere, 1996); Anxiety = Anxiety subscale of the TSCC (Briere, 1996); Aggression = Aggression subscale of the TSCC (Briere, 1996); Trauma = Adverse Childhood Experiences questionnaire (ACEs; Finkelhor et al., 2013); Family conflict = Negative interactions factor of the Network of Relationships Inventory: Behavioral Systems Version – Short Form (NRI: BSV-SF; Furman & Buhrmester, 2009); W2 = Wave 2 assessment; W3 = Wave 3 assessment

Values in parentheses indicate means and standard deviations before imputing the missing data

($ps < 0.05$, Table 3). We next examined models concerning mid-pandemic loneliness. Within our simultaneous model, neither ACEs nor family conflict were significant, while all symptom variables were significant. Within our independent residualized and raw symptom analyses, only anxiety remained significant ($ps < 0.05$, Table 3).

As for demographic considerations, our model first examined the relation between our risk factors and loneliness within the context of race/ethnicity. Regarding the mediation model, findings suggested that family conflict explained more variance in early pandemic loneliness for White adolescents compared to those who identified as Hispanic. These findings are reflected in Fig. 2. Meanwhile, we did not find support for any other mediation model for early or mid-pandemic loneliness with regard to race/ethnicity (i.e., all confidence intervals for the indirect effect included 0). Similarly, moderation models suggested that none of our risk indices varied as a function of race/ethnicity for early nor mid-pandemic loneliness, ($ps > 0.07$).

As for gender, family conflict, ACES, PTSD, anxiety, depression, and aggression all mediated the relation between gender and early-pandemic

Table 2 Bivariate correlations

	1	2	3	4	5	6	7	8	9	10
1. Gender	–									
2. Age	–0.048	–								
3. Lonely_W2	–0.25**	0.047	–							
4. Lonely_W3	–0.34**	–0.005	.56**	–						
5. PTSD	–0.27**	–0.034	.33**	.33**	–					
6. Depression	–0.30**	–0.006	.35**	.38**	.86**	–				
7. Anxiety	–0.40**	–0.042	.37**	.42**	.84**	.82**	–			
8. Aggression	–0.32**	–0.054	.27**	.30**	.86**	.85**	.76**	–		
9. Trauma	–0.14**	–0.072	.21**	.16**	.48**	.46**	.39**	.47**	–	
10. Family Conflict	–0.21**	–0.056	.18**	.20**	.33**	.34**	.30**	.37**	.24**	–

Gender = Female = 0, Male = 1; Age = 1 = 12, 2 = 13, 3 = 14, 4 = 15, 5 = 16, 6 = 17, 7 = 18; Lonely = Three items adapted from the Roberts Version of the UCLA Loneliness Scale including the prompt "Since learning about the Corona Virus, have you felt the following" (Roberts et al., 1993); PTSD = Post traumatic stress subscale of the Trauma Symptom Checklist for Children (TSCC; Briere, 1996); Depression = Depression subscale of the TSCC (Briere, 1996); Anxiety = Anxiety subscale of the TSCC (Briere, 1996); Aggression = Aggression subscale of the TSCC (Briere, 1996); Trauma = Adverse Childhood Experiences questionnaire (ACEs; Finkelhor et al., 2013); Family conflict = Negative interactions factor of the Network of Relationships Inventory: Behavioral Systems Version – Short Form (NRI: BSV-SF; Furman & Buhrmester, 2009); W2 = Wave 2 assessment; W3 = Wave 3 assessment. Correlations represent relations within the imputed dataset

** $p < .01$

loneliness within independent models. In response, all risk indices were entered into a simultaneous model. ACES ($ab_{ps} = -0.02$), family conflict ($ab_{ps} = -0.03$), and PTSD ($ab_{ps} = -0.06$) were iteratively eliminated from models as non-significant mediators. A final model identified anxiety and depression explaining heightened early-pandemic loneliness in girls, and anger/aggression explaining heightened loneliness in boys. Findings from this model are displayed in Fig. 3. As for mid-pandemic loneliness, PTSD ($ab_{ps} = -0.05$), anxiety ($ab_{ps} = -0.13$), depression ($ab_{ps} = -0.08$), and aggression ($ab_{ps} = -0.06$) all emerged as significant mediators within independent models. Within simultaneous models, aggression ($ab_{ps} = 0.04$), depression ($ab_{ps} = -0.06$), and PTSD ($ab_{ps} = 0.03$) were all eliminated in iterative models, leaving only anxiety ($ab_{ps} = -0.13$) as a mediator for heightened loneliness in females. These findings are displayed in Fig. 4.

Finally, moderation models concerning gender were tested. For early pandemic loneliness, family conflict, $B = 0.59$; $t(4, 363) = 2.12$, $p = 0.035$, and trauma-exposure, $B = -0.17$; $t(4,363) = -2.20$, $p = 0.029$, were moderated by gender within independent models. Meanwhile, gender did not moderate any of the pre-pandemic symptoms, $ps > 0.20$. Family conflict and ACES emerged within the simultaneous model as significant as well, with the effects of ACES and conflict both varying as a function of gender. These findings are plotted in Fig. 5. As can be seen, all females (i.e., females exposed to low, average, and high levels of family conflict) experienced early pandemic loneliness above the mean, while only males who experienced high levels of family conflict reported elevated levels of loneliness. As for

Table 3 Identification of convergent significant predictors for early and mid-pandemic loneliness

Lonely_W2									
Simultaneous residualized model				Individual residualized model (Gender and Age as Covariates in each)			Individual raw model (Gender and Age as Covariates in each)		
Variable	*β*	*SE*	*t*	*β*	*SE*	*t*	*β*	*SE*	*t*
(Intercept)	4.81	0.46	10.36**	–	–	–	–	–	–
Gender	–0.54	0.21	–2.57*	–	–	–	–	–	–
Age	0.083	0.086	0.97	–	–	–	–	–	–
PTSD	1.13	0.28	4.01**	0.12	0.10	1.15	0.081	0.015	5.52**
Aggression	0.69	0.25	2.80**	–0.25	0.10	–2.47*	0.075	0.019	3.97**
Depression	1.14	0.26	4.41**	0.25	0.10	2.47*	0.12	0.02	6.01**
Anxiety	1.03	0.25	2.80**	0.13	0.10	1.22	0.14	0.023	6.031**
Family Conflict	0.16	0.14	1.13	–	–	–	0.35	0.14	2.57*
Trauma	0.058	0.043	1.37	–	–	–	0.14	0.039	3.63**
Lonely_W3									
Simultaneous residualized model				Individual residualized model (Gender, Age, Lonely_W2 as Covariates in each)			Individual raw model (Gender, Age, Lonely_W2 as Covariates in each)		
Variable	*β*	*SE*	*t*	*β*	*SE*	*t*	*β*	*SE*	*t*
(Intercept)	3.56	0.44	8.073**	–	–	–	–	–	–
Gender	–0.54	0.18	–3.047**	–	–	–	–	–	–
Age	–0.051	0.071	–0.72	–	–	–	–	–	–
PTSD	0.70	0.24	2.90**	–0.079	0.081	–0.97	0.035	0.013	2.75**
Aggression	0.54	0.21	2.61**	–0.068	0.082	–0.83	0.038	0.016	2.43*
Depression	0.79	0.22	3.54**	0.13	0.081	1.58	0.062	0.017	3.63**
Anxiety	0.75	0.19	3.92**	0.18	0.084	2.11*	0.081	0.02	4.12**
Family Conflict	0.12	0.12	1.054	–	–	–	0.19	0.11	1.68
Trauma	–0.028	0.036	–0.78	–	–	–	0.017	0.032	0.52
Lonely_W2	0.42	0.044	9.59**	–	–	–	0.48	0.04	11.48**

Gender = Female = 0, Male = 1; Age = 1 = 12, 2 = 13, 3 = 14, 4 = 15, 5 = 16, 6 = 17, 7 = 18;Lonely = Three items adapted from the Roberts Version of the UCLA Loneliness Scale including the prompt "Since learning about the Corona Virus, have you felt the following" (Roberts et al., 1993); PTSD = Post traumatic stress subscale of the Trauma Symptom Checklist for Children (TSCC; Briere, 1996); Depression = Depression subscale of the TSCC (Briere, 1996); Anxiety = Anxiety subscale of the TSCC (Briere, 1996); Aggression = Aggression subscale of the TSCC (Briere, 1996); Trauma = Adverse Childhood Experiences questionnaire (ACEs; Finkelhor et al., 2013); Family conflict = Negative interactions factor of the Network of Relationships Inventory: Behavioral Systems Version – Short Form (NRI: BSV-SF; Furman & Buhrmester, 2009); W2 = Wave 2 assessment; W3 = Wave 3 assessment

*$p < .05$; **$p < .01$

ACES, we found a sharp linear increase for loneliness for females, such that greater ACES-exposure led to heightened loneliness, while the simple slope for males was non-significant. As for mid-pandemic loneliness, none of the risk indices varied as a function of gender ($ps > 0.15$).

3 Conclusion

The COVID-19 pandemic has drastically changed the lives of youth across the United States. The goals of the present study were to (a) understand which risks may contribute towards feelings of loneliness during the pandemic and (b) how these pathways operate within the context of race/ethnicity and gender. Findings indicated that depressive and aggression symptoms prior to the pandemic predicted early pandemic loneliness, whereas only anxiety symptoms prior to the pandemic incrementally predicted mid-pandemic loneliness. As for demographic differences, minimal differences were found for race/ethnicity, but several intriguing results were identified within the context of gender. Specifically, environmental stressors were moderated by gender for early pandemic loneliness, and gender-specific symptom mediation pathways emerged for early and mid-pandemic loneliness. Below, we contextualize these findings within the emerging COVID-19 adolescent mental health literature (e.g., Cooper et al., 2021), as well as adolescent adjustment to national disasters more broadly.

In line with previous research during the pandemic (Cooper et al., 2021), we found that symptoms across internalizing and externalizing domains were associated with early pandemic loneliness. That depressive and externalizing symptoms both emerged as unique predictors for early pandemic loneliness suggests that each symptom profile may confer a unique risk mechanism. For instance, adolescents predisposed to depressive symptoms report cognitive styles (i.e., perceived rejection; Oosterhoff et al., 2020) that may be contributing toward experiences of loneliness during the onset of the pandemic. Alternatively, adolescents experiencing depressive symptoms may engage in behaviors, such as social withdrawal despite a desire to connect with others (Achterbergh et al., 2020), that potentiate the limited social connectedness associated with social distancing. With regard to externalizing symptoms, it may be that while some forms of aggression are tolerated, or even rewarded with positive peer attention in normative contexts (Rose et al., 2004), the demonstration of that behavior during periods of mandated social distancing may repel peer interaction. For instance, León Moreno and colleagues (2021) found that higher levels of cyberaggression were related to elevated reports of peer rejection. Finally, findings concerning anxiety's relation with mid-pandemic loneliness signals an important contribution toward understanding perceived isolation in the later stages of the current crisis. A possibility is that although social distancing is an important and essential facet of virus containment, symptoms of anxiety may unnecessarily maintain engagement in these safeguarding practices (self-isolating in the absence of sufficient transmission risk; Shafran et al., 2020), causing these behaviors to persist in ways that increase the likelihood of loneliness. Collectively, these findings suggest that pre-existing mental health remains a potent predictor of youth adjustment during disaster

Fig. 3 Gender specific pathways for early pandemic loneliness. *Note:* Gender = Female = 0, Male = 1; ▶ Loneliness = Three items adapted from the Roberts Version of the UCLA Loneliness Scale including the prompt "Since learning about the Corona Virus, have you felt the following" (Roberts et al., 1993); Anxiety = Anxiety subscale of the TSCC (Briere, 1996); Depression = Depression subscale of the TSCC (Briere, 1996); Aggression = Aggression subscale of the TSCC (Briere, 1996). *$p < .05$; **$p < .01$

experiences, thus building upon past research examining these relations within other disaster contexts (e.g., natural disasters; La Greca et al., 1998).

Interestingly, the significant influence of environmental risk, as measured by ACES and family conflict, on early pandemic loneliness was explained by intrapersonal symptoms and these factors did not relate to mid-pandemic experiences of loneliness. It is worth noting that we did find that parent–child conflict explained more of the variance in White adolescent loneliness compared to their peers who identified as Hispanic; however, given the little incremental validity of parent–child conflict compared to other variables, the translational significance of this finding is negligible. An alternate conceptualization for environmental processes may be that the influence of parent–child conflict and ACES is best understood via indirect pathways. For instance, in past disaster research, Cohen and colleagues (2016) found that environmental predictors (e.g., familial relationships) were best contextualized as a moderator of intrapersonal risks when predicting prospective internalizing outcomes within the context of a disaster. Thus, while ecological risks may not be the best domain to focus on for ameliorating pandemic loneliness in the general population,

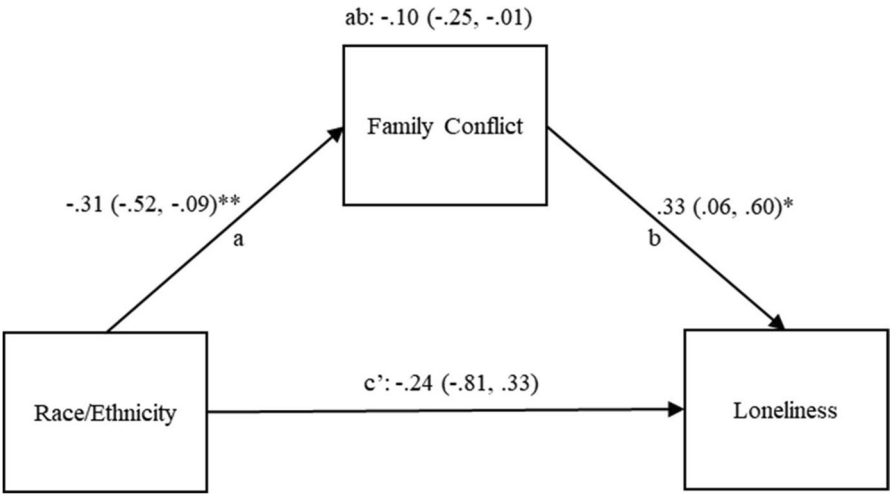
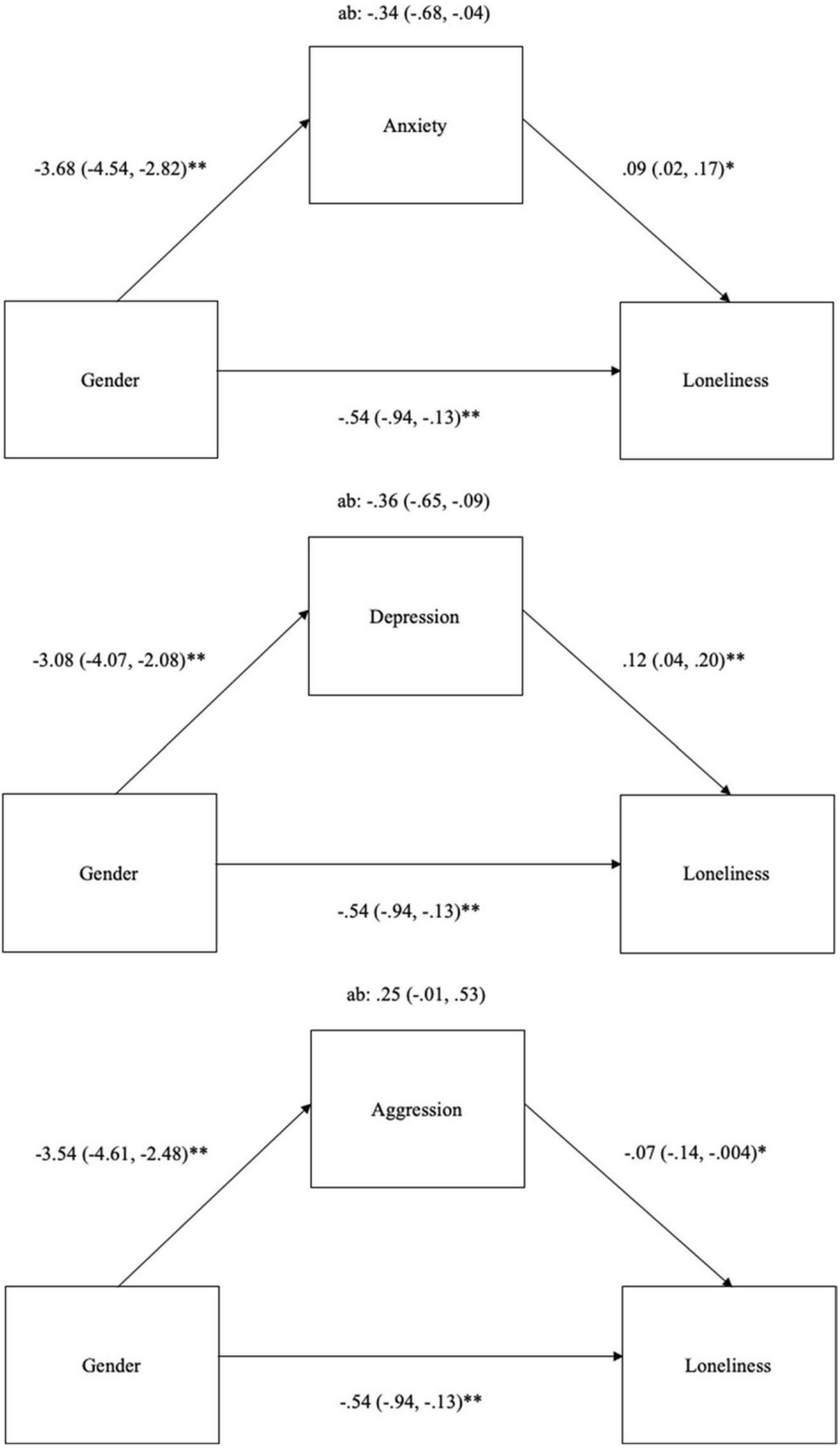


Fig. 2 Relation between family conflict and early-pandemic loneliness for hispanic adolescents relative to white adolescents. *Note*: Race/Ethnicity = Self-reported race/ethnicity; Family conflict = Negative interactions factor of the Network of Relationships Inventory: Behavioral Systems Version – Short Form (NRI: BSV-SF; Furman & Buhrmester, 2009); Loneliness = Early pandemic loneliness measured using three items adapted from the Roberts Version of the UCLA Loneliness Scale including the prompt "Since learning about the Corona Virus, have you felt the following" (Roberts et al., 1993); Values in parentheses represent the lower limit and upper limits of 95% confidence intervals. Coefficients and confidence intervals represent unstandardized values. *$p < .05$; **$p < .01$


ab: -.34 (-.68, -.04)
Anxiety
-3.68 (-4.54, -2.82)**
.09 (.02, .17)*
Gender
Loneliness
-.54 (-.94, -.13)**
ab: -.36 (-.65, -.09)
Depression
-3.08 (-4.07, -2.08)**
.12 (.04, .20)**
Gender
Loneliness
-.54 (-.94, -.13)**
ab: .25 (-.01, .53)
Aggression
-3.54 (-4.61, -2.48)**
-.07 (-.14, -.004)*
Gender
Loneliness
-.54 (-.94, -.13)**

they may have some translational value in identifying who may be most sensitive to certain intrapersonal risks within the context of a pandemic.

As for demographic differences, we found that loneliness, and loneliness risk, did not vary as a function of race/ethnicity. These findings suggest the possibility that emerging adolescent loneliness interventions (see Eccles & Qualter, 2021) may be equitable from a race/ethnicity perspective. Alternatively, several gender specific pathways emerged for early and mid-pandemic loneliness via both mediation and moderation models. With regard to mediation, anxiety and depression explained more of the variance in levels of early pandemic loneliness, with anxiety remaining meaningful for mid-pandemic loneliness for girls, while externalizing distress explained more of the variance in early pandemic loneliness for boys. These findings are supported by prior research that establishes heightened anxiety and depression among females (e.g., Racine et al., 2021) and aggression among males (e.g., Francisco et al., 2020) during the COVID-19 pandemic. These results build upon prior research delineating the relation between pre-pandemic mental health and loneliness among adolescents (Hards et al., 2021) by highlighting the importance of specific pre-pandemic symptom profiles, as the role of these symptoms are unique for boys and girls. Further, our study showed that pre-pandemic anxiety may be particularly important for understanding prolonged experiences of loneliness in female adolescents. Given that females tend to disproportionately experience disaster-related distress (Cénat & Derivois, 2015), future research should examine how anxiety may uniquely contribute to this phenomenon.

Complementary to these findings was the insight gained from moderating analyses. Contrary to hypotheses, as well as past research (Flook, 2011), we found boys to experience more emotional reactivity within the context of family conflict compared to girls. However, as post-hoc results suggested that boys experiencing heightened conflict are experiencing symptoms comparable to girls experiencing low family conflict, the translational significance of this specific finding is limited. Instead, future disaster research may want to examine other familial processes that have been shown to be instrumental in well-being during COVID-19 (parental social support; Wang et al., 2022). Alternatively, examination of the interaction between trauma exposure and gender revealed a linear relation between pre-pandemic trauma exposure and loneliness among girls. These findings are in line with some broader research, which illustrates that females are more likely to experience internalizing symptoms after adversity (Foster et al., 2004), including natural disasters (Groome & Soureti, 2004). Together with our mediation findings, these findings echo recent calls (e.g., John et al., 2020) for more gender-focused preventive programming in the aftermath of national disasters.

Although this study is characterized by several strengths, including pre-pandemic risk indices and a large and diverse sample, a number of limitations are worth noting. First, though the study implemented several methods to alleviate common bias error, including an anonymized data collection and a focus on item simplicity within scales (i.e., few double negative items), measures were single informant. Although adolescents are well positioned to inform on distress and impairment (Smith, 2007), utilizing a multi-informant approach is recommended when examining risk and resilience in adolescents (see De Los Reyes et al., 2015). Second, although we extended previously

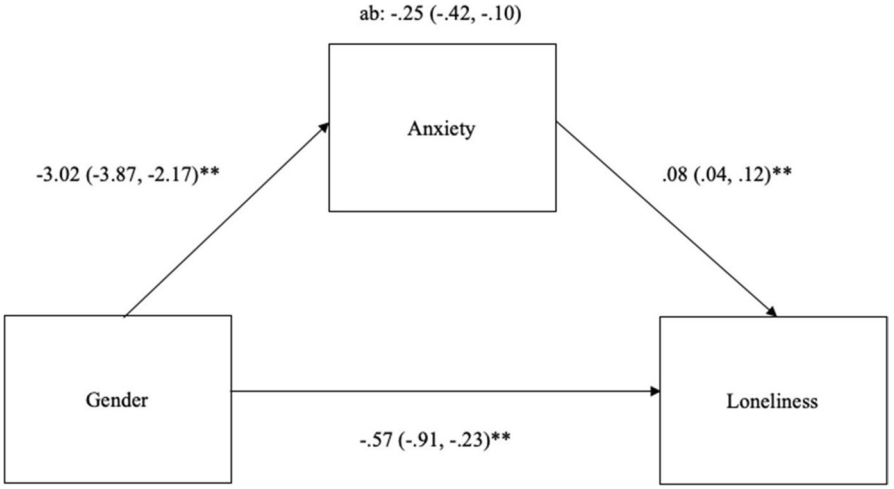


Fig. 4 Gender specific pathways for mid-pandemic loneliness. *Note:* Gender = Female = 0, Male = 1; Loneliness = Three items adapted from the Roberts Version of the UCLA Loneliness Scale including the prompt "Since learning about the Corona Virus, have you felt the following" (Roberts et al., 1993); Anxiety = Anxiety subscale of the TSCC (Briere, 1996). *$p < .05$; **$p < .01$

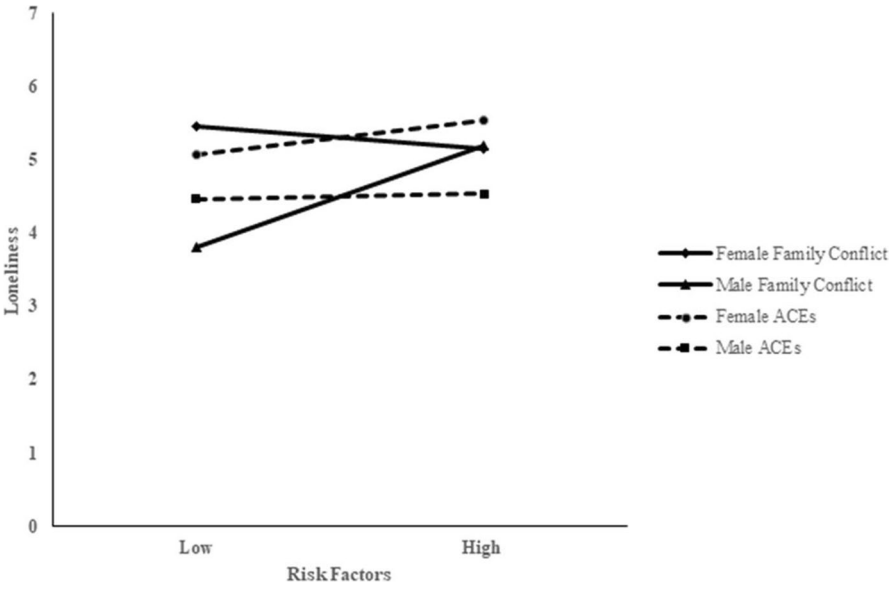


Fig. 5 Gender interactions for family conflict and ACEs for early-pandemic loneliness. *Note*: Gender = Female = 0, Male = 1; Loneliness = Early pandemic loneliness measured using three items adapted from the Roberts Version of the UCLA Loneliness Scale including the prompt "Since learning about the Corona Virus, have you felt the following" (Roberts et al., 1993); Family conflict = Negative interactions factor of the Network of Relationships Inventory: Behavioral Systems Version – Short Form (NRI: BSV-SF; Furman & Buhrmester, 2009); ACEs = Adverse Childhood Experiences questionnaire (Finkelhor et al., 2013)

identified relations between loneliness and predictors (e.g., Lalayants & Prince, 2015), our measure of loneliness was introduced in response to the COVID-19 pandemic, and thus not collected at baseline. As such, we were unable to examine the relation between loneliness and our predictors outside the context of the pandemic. In addition, although our study relied on a two timepoint study design, extending these findings into a multi-wave, longitudinal design within a multilevel structural equation or growth modeling framework may provide further insight into the temporal nature of the relations identified. Stressor characteristics may also impact the emergence of outcomes, such as loneliness. Thus, in line with other studies capturing how components of the COVID-19 pandemic are related to perceptions of negative outcomes (e.g., Mahmoud et al., 2022), such as loneliness, further evaluation of COVID-19 characteristics represents an important next direction. Finally, although our study intentionally selected loneliness as our criterion given its relevance within a post-disaster context, our study is unable to speak to other adjustment outcomes. For example, given the ties between pre-existing mental health concerns and other post-disaster responses (e.g., Cohen et al., 2016), it will be important to understand whether particular risk mechanisms relate to other patterns of distress and impairment as well. Despite these limitations, our findings provide new insight into youth adjustment during this unprecedented era. As the COVID-19 pandemic continues to affect adolescents worldwide, it will be important to build upon the findings from the current study to understand how the profiles identified may exacerbate risk for long-term responses, particularly as adolescents begin to transition into young adulthood.

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Authors Contribution HT conceived of the current analysis and drafted the manuscript; MS drafted the manuscript; JC participated in data collection, data curation, project administration, and drafted the manuscript; JRT conceived the overall study and reviewed the manuscript, JRC conceived of the study, data curation, conceived and performed the statistical analysis, and drafted the manuscript.

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Declarations

Conflicts of Interest The authors have no conflicts of interest to disclose.

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